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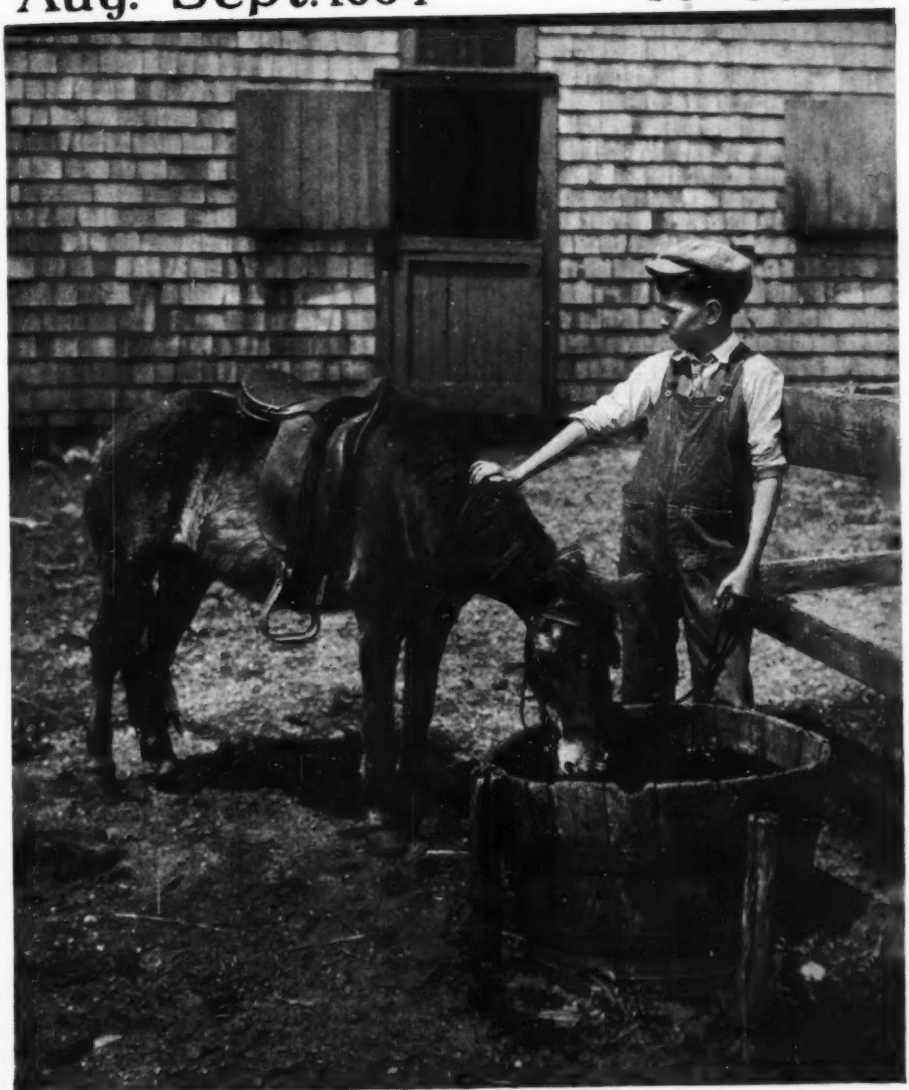

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SOYBEANS, like other legumes, can get nitrogen from the air but they draw heavily on the soil for phosphorus and potash, particularly potash. Each ton of hay removes about 47 pounds of actual potash, equal to 94 pounds of muriate of potash.

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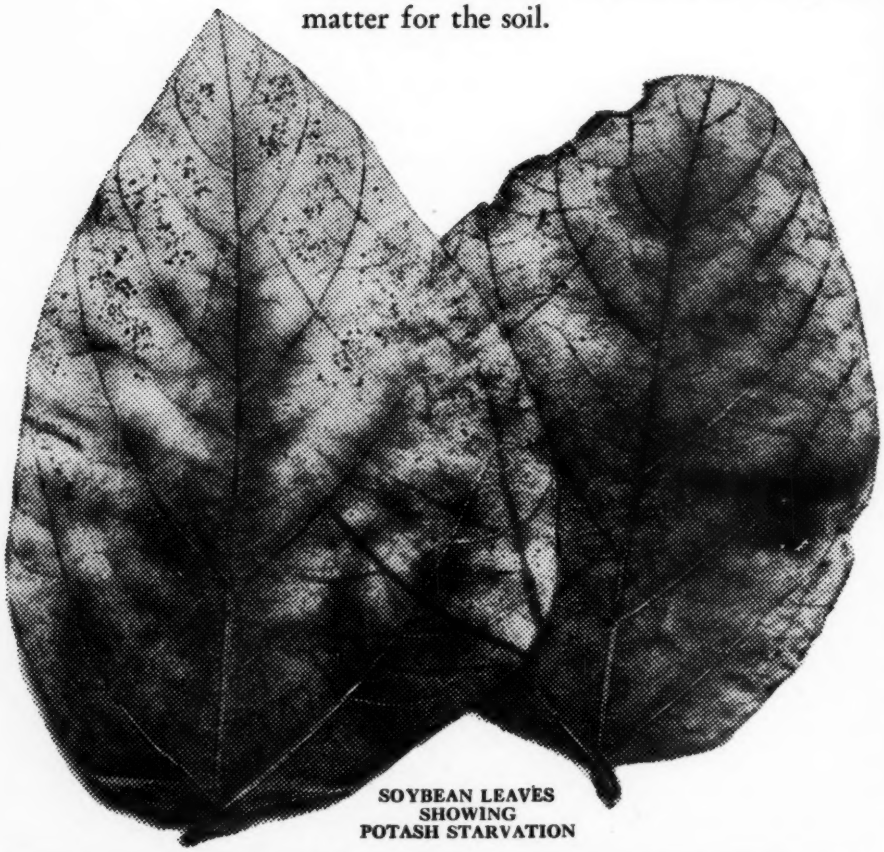

SOYBEAN LEAVES SHOWING POTASH STARVATION

Better Crops with PLANT FOOD

The Whole Truth — Not Selected Truth

R. H. STINCHFIELD, *Managing Editor* SID NOBLE, *Editor*

Editorial Offices: 19 West 44th Street, New York

VOLUME XIX NUMBER NINE

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BEWARE!

Better Crops with PLANT FOOD

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VOL. XIX NEW YORK, AUG.-SEPT., 1934 No. 9

Consider the workings of—

Nature & Co.

By Jeff McDermid

LET'S face the dwindled harvest without any shattered ideals but with a few new ideas on frustrated planning. Burns made a mousey poem about programs that sometimes went awry. Instead of dismissing that as inevitable, it seems to be wiser for us to see if future troubles coming from past errors cannot be fixed in the future. (Don't be perturbed. No recipes to follow.)

Nature & Company are responsible for running the works on this panicky planet. Nature is the chief stockholder and silent partner, while Co. stands for comrades, communities, or common folks. Nature may be human, animal, or vegetable, or else the neuter elements of drought, storm, and flood. What man proposes God disposes is just a shorter way of saying that nothing is finished until the Senior Partner is considered or perhaps coerced into cooperation. Nature as the Senior Partner has a hand in everything.

If there is an unreasonable, erratic, or temperamental Boss of the Firm, what does the Company do if it can't

buy out his interest and fire him? In that case the only way out is to order the procedure in such a way that the Boss is dodged in his worst moods and then gradually led to see that unless the Company is consulted a little, there won't be any firm left to lord it over. The dodging process goes with elemental Nature and the coercive method will be necessary with human Nature. So We, Us and Co. have a little diplomacy cut out for the next few decades.

Prior to this we have been contented to act like "teacher's pets" with Nature, both elemental and human; keeping up a soft-soaping or a boot-licking attitude just to be certain that we are playing safe. We said that the kids and their offspring could take care of themselves in the future just as we had—if we gave them a little coaching in a course of artful dodging, temporizing, and time-serving. But teacher hasn't been keeping any pets lately, and so those old easy ways to exist in blind blandness are out the window.

After removing my coat to get a better purchase on the problem, I'll tackle one of our worst maladjustments. It arose from a combination of human cussedness and natural barrenness, to wit, the great American land-go-mania. If ever there was a worse era of misguided expansion a la Colonel Sellers, P. T. Barnum, and Baron Munchausen, we failed to meet it. The promoters were able to use letterheads and calling cards bearing the endorsement of eminent statesmen, and the part played by Uncle Samuel and the State colleges is nothing to which we can pridefully point.

YOURS truly also was guilty. Along in yonder years we were among a lonely party of prairie dogs who braved the dry-land mosquitoes, the chinook winds, and the loco fever to stake a claim amid the Dakota cattle ranchers in the Trans-Missouri country. Oh, yes, it was a grand, full, and free experience—on the cloud-shadowed upland plateaus, with a smelly pipe, a tar-paper shack and a pinto pony—15 acres of land and a back, both broken getting ready to swear we were dirt-plow farmers at the one-horse land office on the Cheyenne. Bad lands glittering in waving mirages to the southeast, bunch grass and rattlesnakes, coyotes and owls, the horned lark for company, and the mouth organ for amusement. A trifle later, a final payment of one dollar and a quarter an acre, followed by transfer to a bona fide squatter who stayed squat, for twelve dollars. Consideration, cash for a portion and vague promissory pledges for the rest. Ten years later a return visit to the optimistic purchaser indicated an increase in children, sunburn, and financial obligations after sticking out seven lean years on the half section in hopes and sacrifice. I should like to know at this writing whether Bob Fuller is living after several more years of similar grubbing on the buffalo sod, and I am willing to bet that he is one of the thousands now on enforced relief rolls because of drought.

NOW Bob came there because he was young, iron-muscled, and farm-bred back in Ioway. He had grown restive under the big-acre-price talk of the cronies at home, hanging onto their ancestral corn lands like hogs to a milk trough. He was a sort of "teat pig" among the drove around the agricultural larder and so he, like countless other brave young lads, grabbed the bulky Missus and the other lares and penates and sought a place where he could reach out his arms like Max Baer and claim he was the champion —or something. I remember how cordial he was to the skeptical cow men and ornery sheep herders of the Dakotas. He uncoiled his barb wire and drove his stakes cut in the cottonwood draws, and built his shack on the top of a windy hill with the help of his wife and girls. Always grinning and level-headed and square as a die.

Under any of God's decent farm conditions Bob Fuller would have made

the old sod sing in seed time and harvest, and his bullocks would have pleased the best of judges from anybody's International. He lifted a brawny arm right manfully to repair the schoolhouse and erect a new flag pole, declaring that Francis Scott Key was not the only chap who was in distress while the banner waved in the breeze. He had all the attributes of empire making and home founding and ancestor worship, but the trouble was

that he was only part of the Company, and Nature was the Boss of the Firm.

Poor old Bob, I suppose his hair is gray as a coyote's flanks now, and some of that vim has been plowed deep into the dusty hard-pan of the country that God forgot. I am not crowing because I escaped the same fate, but I am hot as blazes over the era that led Bobs like him to put their manhood into a dead-sure misfire. It took a lot of punishment for the country as a whole to wake up and blink their goggle-eyes at such conditions. But thank my stars they are on the right trail now, and the pack train is loaded with enough grub and ammunition to see us through—unless some blank-headed Congressman or Senator chooses to sell his country's honor and future security for a mess of political pottage.

And that wasn't all my close relations with land boomers either. The medicine men of the grab-and-go tribe mixed up plenty of dirt for the folks back in the older settlements too. The eloquent Chambers of Commerce and the Handshakers' local dining contingents lent a shove to the movement landward and stumpward in the burned-off, second-growth, joy-forsaken mesas where the lumber barons had skimmed off the wealth put there by sunshine, rain, and protoplasm. Theirs was a combination of beckonings to the young landless farmers in the Midwest and the immigrants who "ought to settle in the region where climate and congenial nationalists abound, to feed the soul and replenish the earth."

The North Central cut-over regions were painted as reaching out tempting prizes to Germans, Swiss, Norwegians, and "what have you" from Europe's temperate zone. Some of our staid professors got het up over it all and lent their magic and scientific standing to the drainage and the root-yanking process designed to fit the pulsating land to the approach of the husbandman. "Why waste time fertilizing old farms," they said, "get out in the clover-green natural areas where an axe and a bonfire will provide entrance to the greatest among the lands yet untouched by man." Ergo, if one-thousandth of the money thus tossed into stump fires could have been invested in balanced fertilizer on the farm lands which would have amply supplied us, the long, sad story would not be told.

Not all voices were raised in a chorus for transplanting the land-hungry and teaching them how to blast their way into perpetual debt by dynamite in snag clearing. I recall at least one thoughtful immigration officer who tramped many miles talking with prospective settlers and investigating the actual worth of the soil with spade and auger. But he fought against stiff odds and had a big territory to cover.

Incident to the mania for stump dentistry, we had in the Lake States a

well-organized traffic in sand barrens and peat marshes. Folks whom Uncle Sam could not use on irrigation projects were easy marks for the "realtors" who ran midwinter excursions during deep snow spells to show off their bonanzas to factory-sick heads of families. I recall also a colony of solemn Chinamen who brought their wash tubs along and tried to raise goobers and ginseng on sandbur plantations fringed with jackpines and general desolation. Weird farm hands they were, too, for stories were rife of how they stuck certified Cobblers, eye-up, three feet deep in the drifting sand and muck, being told to beware of frost. Perhaps it was a conspiracy, their idea being to sprout the tubers and harvest the crop in China. In a year or so the only remnants left were a few hard-headed native cranberry growers located on their reservoir projects, reinforced by a shrewd and capable sales company shoving a scarce article. But mind you, these fairly successful specialists came into this area in the early nineties, and the recent ballyhoo meant nothing to them but scorn.

THIS much must be said in justice to the State wherein much of this unwise expansion took place. Their leaders have since sorted over the acres with economic eyes, issued careful analyses of the specific use to which various areas are suited, and actually moved some of the isolated victims of the "occupation orgy" down to more civilized and well-knit communities. Indeed, the great national land-planning project now taking shape to prevent all such crazy conquests finds excellent examples of its benefits right in the midst of the worst field of free-for-all land abuse and man-killing. But there's no place like a hospital for a clinic anyhow.

Land is not sub-marginal until somebody tries to farm it under difficulties, whether of soil, climate, or economics. But in that case the operator also becomes sub-marginal. But land which has two of the adverse conditions against it, soil and climate, is surely handicapped in conjunction with the third element, economic conditions at large.

It would seem common sense for a gradual retirement, therefore, of areas which were evidently made for or made over into regions for the hunter and the summer resorter. Let the nudists take them for their retreats. They have stripped most folks who tried to farm them.

Then we may be better assured that a dollar spent for fertilizer will return real profits and satisfaction and that the total production valuation may not be constantly threatened by so-called virgin acres,—which by the way are better off as "old maids" than married to a farmer who can't support himself.

THE drought in some of the Midwestern areas of intensive dairying has naturally led to bunching herds for grazing, using brands like the cowboys to identify their cattle. Nearly half a million head of these bony derelicts of dairying had gone to Government slaughter by July 1. This, too, harks right back in some cases to overstocking of unsuited lands. Overstocking western ranges is bad enough, but carrying too many cattle where every spear they eat must come from mechanical agriculture dependent upon intensified soil fertility—that is waste incalculable.

Old Boss Nature suddenly went cranky and dried up in some of the regions where he had previously been generous. But his partners in husbandry bet the wrong way on the old gent's temper, and found that it takes more than the master's eye to fatten the herds and flocks when there are no ways to tell when the Chief will make it hot for the rest of the firm.

This brings up the matter of being able to dodge the worst drought effects by careful advance planning. Science is making observations that

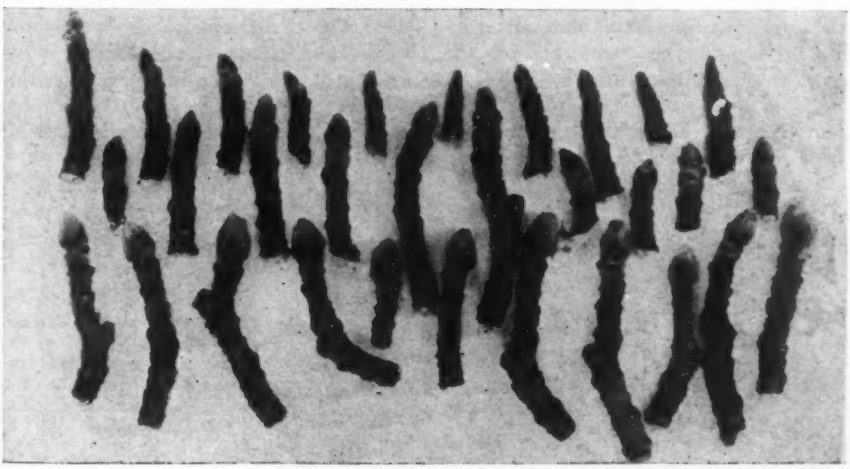
(*Turn to page* 31)

Phosphorus *and* Potash Responses *in* Apple Trees

By Fred W. HofMann

In Charge of Horticultural Research, Virginia Agricultural Experiment Station

CHEMICAL analyses of the fruit of apples show that 100 pounds of apples remove about .059 pounds nitrogen, .027 phosphoric acid, and .16 pounds potash from the orchard soil. Analyses of the foliage and wood of 40 apple trees show the following intake—.08 pounds nitrogen, .02 pounds phosphoric acid, and .06 pounds potash the first year after setting out in the orchard; 11.85 pounds nitrogen, 5.74 pounds phosphoric acid, and 14.22 pounds of potash the ninth year after setting; and 28.10 pounds nitrogen, 9.26 pounds phosphoric acid, and 27.22 pounds of potash for the entire nine years. During these nine years the amount returned to the soil by foliage is 12.84 pounds of nitrogen, 2.53 pounds phosphoric acid, and 12.97 pounds potash leaving a net removal of 15.26 pounds of nitrogen, 6.73 pounds of phosphoric acid, and 14.25 pounds potash. It is seen from these analyses that the heavier removals are for nitrogen and potash and that both of these removals are in a very close proportion.



Fruits Buds Taken from Differently Fertilized York Apple Trees—Horticulture Department, Virginia Agricultural Experiment Station. One year after fertilizer application.

Upper row—Check—No fertilizer.

Second row—From trees receiving nitrogen only

Third row—From trees receiving same amount of nitrogen as the second row but also phosphorus and potassium.

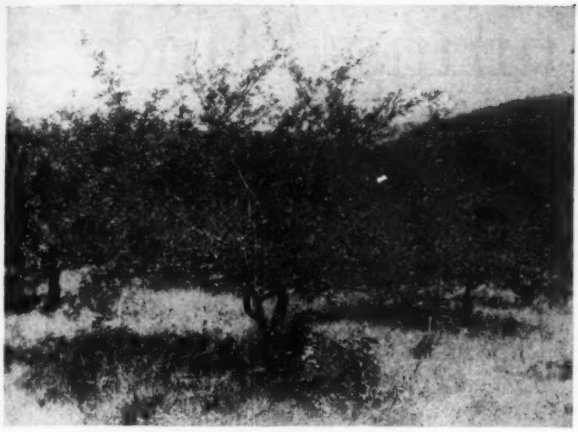
TABLE I—Approximate Amounts of Nitrogen (N), Phosphoric Acid (P_2O_5), and Potash (K_2O) Taken up by Trees of a Given Circumference With a Given Total Yield.

Age Years	Size of Circumference Inches	Total Average Yield of Crop Pounds	—Amount of Elements in Pounds Taken Up—	N	P_2O_5	K_2O
1-6	1-11		In wood	.5	.12	.4
			In fruit	0	0	0
			Total	.5	.12	.4
6-11	11-21	500	In wood	5.0	1.0	4.0
			In fruit	.3	.14	.8
			Total	5.3	1.14	4.8
11-16	21-31	2,000	In wood	20.0	6.0	16.0
			In fruit	1.2	.5	3.2
			Total	21.2	6.5	19.2
16-21	31-36	3,500	In wood	31.0	9.0	23.0
			In fruit	2.0	1.0	5.6
			Total	33.0	10.0	28.6
21-26	36-41	6,000	In wood	44.0	13.0	34.0
			In fruit	3.5	1.6	9.6
			Total	47.5	14.6	43.6
26-31	41-46	10,000	In wood	54.0	16.0	42.0
			In fruit	5.9	2.7	16.0
			Total	59.9	18.7	58.0
31-36	46-51	15,000	In wood	68.0	20.0	52.0
			In fruit	8.9	4.0	24.0
			Total	76.9	24.0	76.0

Approximations have been made by the writer for the amounts of the three elements taken up in wood by the time apple trees reach a given circumference. These are brought out in Table I. Average crop yields for trees of different circumference were estimated, and on the basis that 100 pounds of fruit use up .059 pounds nitrogen, .027 pounds phosphoric acid,

The trees on this and the opposite page are Grimes Golden apple trees of the same age and from the same orchard at the Virginia Agricultural Experiment Station.

Left—Nitrogen Alone



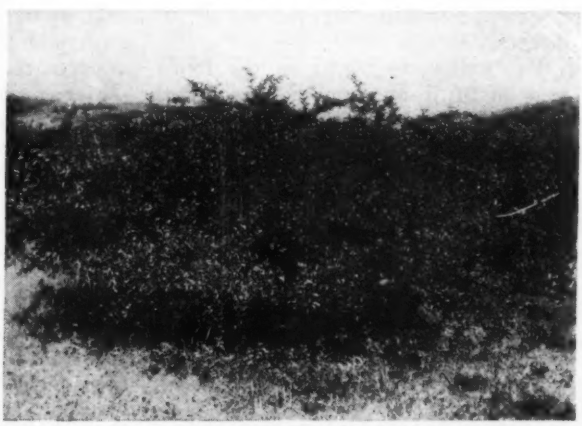
Unfertilized

and .16 pounds potash, the total amounts of these three elements taken up over certain periods are indicated. According to the approximations in Table I, by the time a tree has grown to 40 inches in circumference its wood will have taken up 44 pounds nitrogen, 13 pounds phosphoric acid, and 34 pounds potash. With a total yield of 6,000 pounds of apples, an additional 3.5 pounds nitrogen, 1.6 pounds phosphoric acid, and 9.6 pounds potash will be withdrawn making a total removal of 47.6 pounds nitrogen, 14.5 pounds phosphoric acid, and 43.6 pounds potash in a period of some 25 years.

On the whole, more stress is generally laid upon the value of either phosphorus or potassium to the cover crops rather than to the direct benefit that may be secured by apple trees themselves. To be sure, the more direct responses are first noticeable by the cover crop growth. Cover crops are the first to get the benefits of phosphorus and potassium applications when these elements are necessary in the soil, but ultimately, direct responses will show also in the apple trees. Excellent examples of such responses in apple trees are present in some extensive experiments carried on by the writer since the fall of 1930.

One set of trees was given an application of 10 pounds calcium cyanamid per tree, another the same equivalent of nitrogen but with phosphorus, and the third with potassium added. The more immediate response showed up in a heavy cover crop growth by the last of May in the plats that had either phosphorus alone or phosphorus and potassium added. By the end of the dormant season of the next fall, the trees in the latter plat showed up with much heavier growth, but most strikingly with the larger and heavier fruit buds. The contrast in the size of the fruit buds is best brought out in the accompanying picture. The upper row of buds in this picture was taken at random from the check York trees, those in the second row from

(*Turn to page* 29)



Nitrogen—Phosphorus—Potash

The Inquiring Mind *and the* Seeing Eye

By Dr. A. S. Alexander

University of Wisconsin

OUT in California, Dr. W. P. Kelley, soils chemist of the University and of the Citrus Experiment Station located at Riverside, has proved a real Elisha to the fruit growers and farmers of that State.

When Elijah, the greatest and sternest of the Hebrew prophets, was caught up in a whirlwind, Elisha, his disciple, donned the mantle of his teacher, carried on his work, and became the restorer of peace and prosperity in distress and drought devastated Israel. One of his beneficent acts was the healing of the water of Jericho by putting salt in it for land where "the water was naught and the ground barren," and another the bringing of water to the army of Jehosophat in the arid wilderness of Edom by "making the valley full of ditches."

Dr. Kelley, following in the footsteps of his illustrious predecessor Dr. E. W. Hilgard, like Elisha, has successfully coped with the problems of irrigation, water supply, and the banishment of barrenness in millions of acres of once desert land in the Golden State.

He has fought the demon of black alkali which rendered the vast areas of sun-kist land absolutely sterile, and has shown how white alkali, another enemy of citrus trees, grapevines, and other fruit-producing plants, may successfully be overcome. As a result of the painstaking scientific work of himself and his able assistants, E. E. Thomas and S. M. Brown, soil that could raise nothing but a heavy crust of plant-destroying chemical salts has been made to produce 10 or more tons of alfalfa per acre annually, and great tracts which once were clad with prolific vineyards, but became sterile by alkali prevalence, have been restored to productiveness.

The Quality of Water

We who have not had to deal with farming problems in arid sections of the country may have had an idea that the provision of abundant water for irrigation purposes would, with certainty, make such sterile areas "blossom like the rose" and become lands "flowing with milk and honey," but that, apparently, is not the case. The quality of the water supplied is of vital importance. The beneficent rains from the skies cannot be excelled for plant watering and, in California, water from the snow-capped peaks of the Sierras would come next in quality; but the supplies of such priceless water have been inadequate and much water, available for irrigation purposes, is highly impregnated with noxious salts which add to the difficulty of the alkali problem. This matter has had to be studied and the difficulty overcome by Dr. Kelley and his associates, as well as the removal of alkali from both the surface soil and the subsoil, in order that arid lands may be made

productive. Success has blessed their efforts, but the good Doctor still wishes that some plan could be devised to insure adequate supplies of purer water for irrigation purposes.

He and E. E. Thomas believe that the excellent water which falls in the mountains of California may be so conserved as to augment materially the volume of water now obtained from them, thereby making it pos-

Dr. W. P. Kelley

sible to discontinue the use of at least a portion of the saline water. Concentrations of boron, we are told, occur in certain waters of southern California that are toxic to citrus and walnut trees. In some small areas injurious quantities of soluble boron also occur in the soil. Leaves of citrus trees poisoned by boron tend to fall off in the winter and early spring months. Boron-affected walnut leaves also tend to fall off prematurely. When boron is introduced in irrigation water it gradually accumulates in the upper layers of the soil, as a result of evaporation. Heavy rains may carry downward some of the boron, from time to time, and thus retard the accumulation of soluble boron in the region of tree roots.

For many years, copious irrigation justly was deemed the boon and blessing we have mentioned, for on wide areas of previously sterile land, its advent made establishment of thrifty orchards of citrus trees and prolific vineyards possible. But in time the prolonged flooding of the fields with water induced new problems which Dr. Kelley has had to tackle and solve. Originally the "water table" was far down under the soils made fertile by irrigation. Gradually it rose so that roots of the growing plants, by capillarity, drew alkali-impregnated water from the saturated subsoil and were killed thereby; then evaporation surcharged the surface soil with alkali and plant growth became impossible. These soils which had reverted to their pristine, sterile, alkali-poisoned condition were studied and experimented upon by Dr. Kelley, and it is through his success in restoring them to fertility and productiveness that great fame has come to him as a research soil chemist.

Shares Credit

And now that he has become deservedly famous, it is fine to note that he does not take all the credit to himself, but cheerfully grants a great measure of it to his capable assistants and never forgets what he owes to his teacher and counsellor, the late Dr. Hilgard. Of that eminent gentleman and scientist he graciously says:

"Those who are familiar with his extensive publications, realize that the principles enunciated by him are not only sound, but far reaching, both in theory and practice. He who essays to investigate any of the various phases of the alkali problem will do well indeed to scrutinize the publications of Dr. Hilgard. Endowed with an unusually keen mind, broad training, and enthusiastic devotion to theory and

practice, the major portion of his active life was spent on this subject. The compass of his researches is far greater than casual reading will reveal, and the results of his labors will continue to yield an unmeasured harvest. The present-day student of this subject has a rich heritage in his records."

"Never-say-die"

Dr. Walter Pearson Kelley is of Scotch-Irish extraction, which no doubt accounts for much of the determination, perseverance, and exactitude of his character. The "never-say-die" trait of the Scot is stamped upon his countenance and he possesses too, the alertness, humor, and congeniality of the high-class Irishman. He was born February 19, 1878, at Franklin, Kentucky, the son of John W. and Mary Eliza (Mayes) Kelley, both of whom were descendants of early colonial immigrants, the former having settled in North Carolina in pre-revolutionary days, and the latter in Virginia, about the same time. He was reared on a farm in southern Kentucky and obtained his preliminary education in the country schools and high school of the community. In 1900, he entered the Chemistry Department of the State University of Kentucky at Lexington, from which institution he graduated in 1904, with the degree of B.S.

The following collegiate year he pursued graduate studies in the same institution. In 1905 he accepted a position as Assistant Chemist at the Indiana Experiment Station of Purdue University, which position was held until June, 1908. The years 1906-1907 were spent in graduate work at Purdue University in connection with Experiment Station duties, for which he received the M.S. Degree in 1907.

In July, 1907, he accepted a position as Chemist to the Hawaii Experiment Station, Honolulu, which position was held for a little over six years. During this period he pursued graduate studies under the late Dr. E. W. Hilgard. In the years 1911 and 1912, he was a graduate student at Berkeley, in connection with which the degree of Ph.D. was granted in 1912. On August 6, 1913, he was married to Miss Sue Kathrine Eubank. From 1914 to date he has held his present position.

Doctor Kelley was elected to Sigma Xi, Alpha Tau Omego, and Phi Beta Kappa, and the honorary chemical fraternity, Phi Lambda Upsilon. He was president of the American Society of Agronomy in 1930, and is a member of the following scientific societies: Fellow of the American Association for the Advancement of Science, American Chemical Society, American Society of Agronomy, Western Society of Naturalists, Western Society of Soil Science, and International Society of Soil Science. In 1933, he was elected one of the twelve soil scientists from different parts of the world who were requested to submit manuscripts for a Jubilee Number of the Hungarian Journal of Soil Research, which was issued in honor of Professor A. A. J. de'Sigmond, an international authority on Soil Science. Doctor Kelley has for years been a member of committees of the International Society of Soil Science and of the National Research Council.

Research in Soils

From the first Dr. Kelley has been engaged chiefly in soil chemistry research work. When in the Hawaiian Islands, he devoted his attention principally to the pineapple-producing soils, with the result that the relation of manganese to the troubles affecting the pineapple was discovered. He also studied, to some extent, the rice soils of the Islands and established the fact, which has subsequently been abundantly confirmed, that rice absorbs its nitrogen chiefly in the form of ammonia. His work in Hawaii likewise led to a sound basis of fertilizing rice crops.

In his studies of the alkali problem in California, Dr. Kelley has examined

(*Turn to page* 27)

A cluster of typical Fuerte avocado fruits.

Fertilizing *for* Better Avocados

By E. E. Knight

Fullerton, California

THE growing of the avocado is comparatively a new industry in California, but owing to increased demands due to its rapid growth in popularity, large plantings have been made. Consequently, it is now assuming the proportions of a major industry.

Because of the short period this fruit has been grown on a commercial scale, little is known regarding its fertilizer requirements. An analysis of the flesh of the fruit, taking the Fuerte variety for example, showed that 2,000 pounds will remove from the soil 4.67 pounds of nitrogen (N), 5.29 pounds of phosphoric acid (P_2O_5), and 8 pounds of potash (K_2O). Comparing this analysis with that of many other fruits, it will be noted that the demands of the avocado for phosphoric acid are unusually heavy. The potash requirement also is unusually heavy, exceeded only by the olive.

From a study of this analysis, it was evident to the writer that phosphoric acid and potash must play a very important part in the fertilization of the avocado. Consequently, in order to get a better understanding as to its fertilizer needs, in 1930 different fertilizer tests using 100 fruiting trees divided into 10 plots were started.

There were test plots in which nitrogen, phosphoric acid, and potash were used separately; test plots of nitrogen and phosphoric acid; also of nitrogen and potash used in combination; and one plot in which all three were employed. One plot was given a straw mulch only. Two tests were made with phosphoric acid and potash applied broadcast. All other tests had the phosphate and potash either placed about three inches under the surface or dissolved in water and applied in a band about four feet wide around the drip of the tree. This last method was the practice employed in most cases.

Time Tests

These tests were followed up for four years, with the exception of that of nitrogen alone and where the phosphate and potash were broadcast. At the end of the third year, the trees in the nitrogen test showed die-back at the ends of the new growth, and the crop was the poorest of all the tests. On the location where the phosphate and potash was applied broadcast, some irrigation difficulties were experienced. For these reasons these two tests were discontinued.

The soil used had received straw mulch and manures. All tests were under the low sprinkler system. Naturally there was a certain amount of carry-over of nitrogen, phosphoric acid, and potash. The amount of fertilizer used depended upon the diameter of the trunk in inches one foot above the ground.

The treatments given were as follows: (for ease of calculation the figures are all based on trees as being ten inches in diameter at one foot above the ground) each of the trees in the NPK plot were given 20 pounds of a 5-10-10 fertilizer equivalent to 1 pound of nitrogen (N), 2 pounds of phosphoric acid (P_2O_5), and 2 pounds of potash (K_2O). The amounts applied to the trees receiving but two elements were 1½ times as much of each as given to the trees receiving the 5-10-10, thus in the NP plot each tree received 1½ pounds of nitrogen, and 3 pounds of phosphoric acid. In the NK plot each tree received 1½ pounds of nitrogen, and 2 pounds of potash. In the PK plot each tree received 3 pounds of phosphoric acid and 3 pounds of potash. Where but one element was applied the amount given each tree was double that applied in the 5-10-10 plot, thus, the trees receiving nitrogen only were given 2 pounds of nitrogen, the trees receiving phosphoric acid only were given 4 pounds of phosphoric acid, and the trees receiving potash only were given 4 pounds of potash.

At the end of the four years (three years for nitrogen alone) the fruit was tested. The nitrogen test produced the fruit of highest flavor, but it darkened almost as soon as cut and would not stand shipment. The fruit from the phosphoric acid test lacked flavor and shriveled badly at the stem end. The potash test yielded fruit that was superior in flavor to that of the phosphoric acid though not as good as that of the nitrogen test, but this fruit gave the highest shipping test of all. Covering the four year's set of fruit, phosphoric acid set the largest crops, but later dropped most of it. Phosphoric acid and potash set well but dropped some fruit. Potash set small crops, but the fruit did not drop. The mulched test was about medium in every way.

The Yields Compared

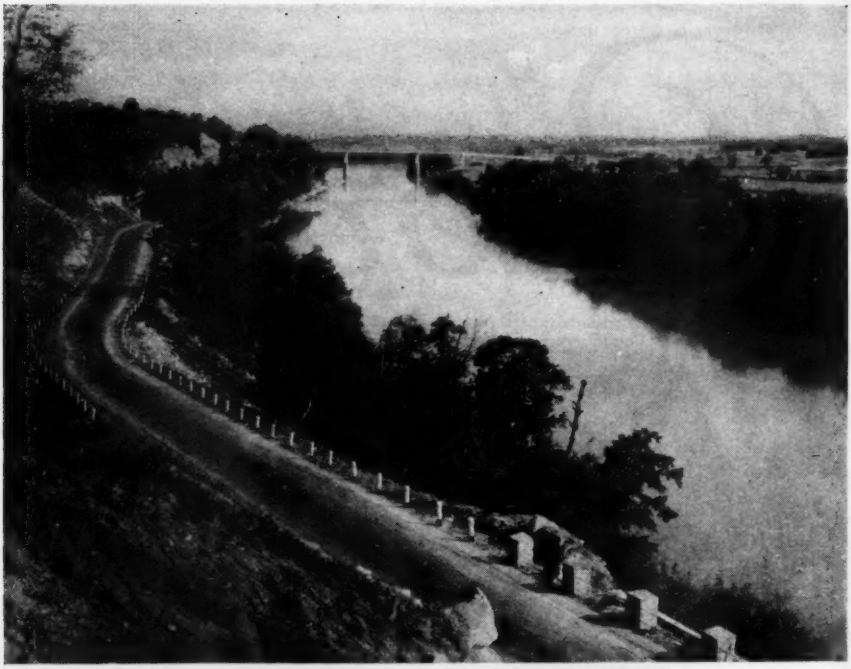
The crop of fruit for the last year of these tests, given in pounds per tree, was: nitrogen (alone) 6 pounds; potash (alone) 24 pounds; phosphoric acid (alone) 70 pounds; nitrogen and phosphoric acid 80 pounds; nitrogen and potash 76 pounds; phosphoric acid and potash 112 pounds; nitrogen, phosphoric acid, and potash 310 pounds; and straw mulch 100 pounds.

Judging from the appearance of the foliage and wood growth at the end of the four years of fertilizer test, the complete fertilizer was best, potash

(*Turn to page 26*)

Pictorial

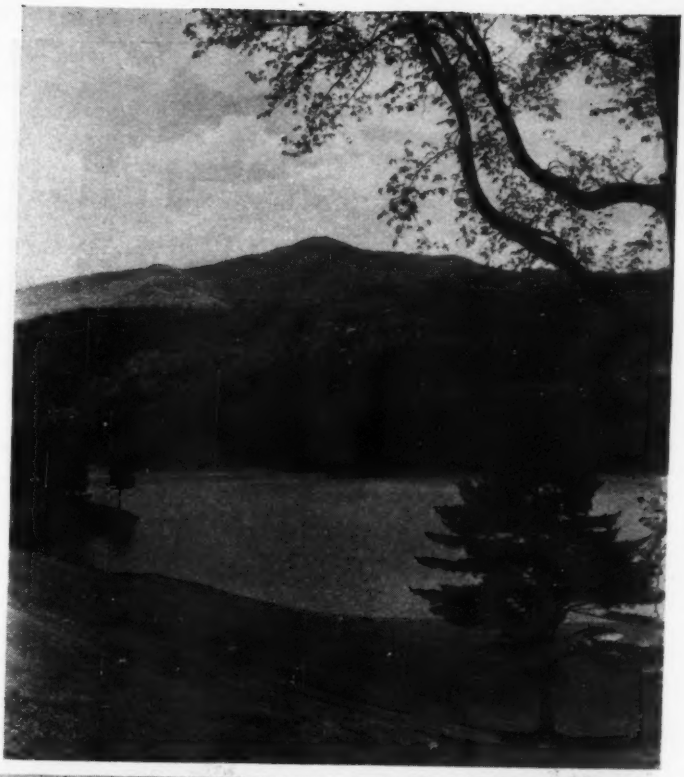
BRUSHING UP FOR SCHOOL.



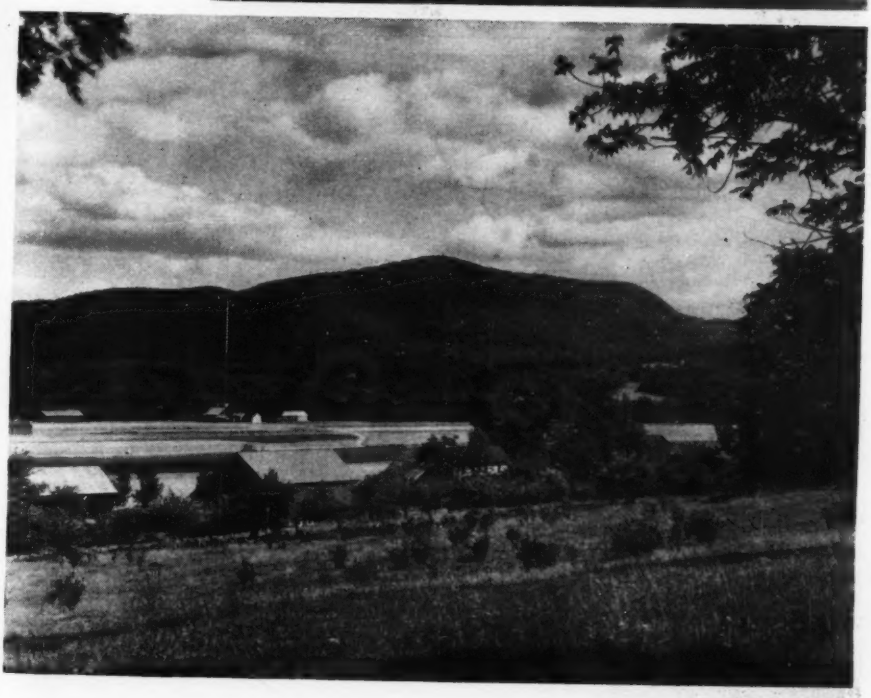
Above: The Cumberland River near Clarksville, Tennessee.

Left: A pretty scene near Lake Charles, Louisiana.

Right: Mt. Ascutney near Windsor, Vermont.

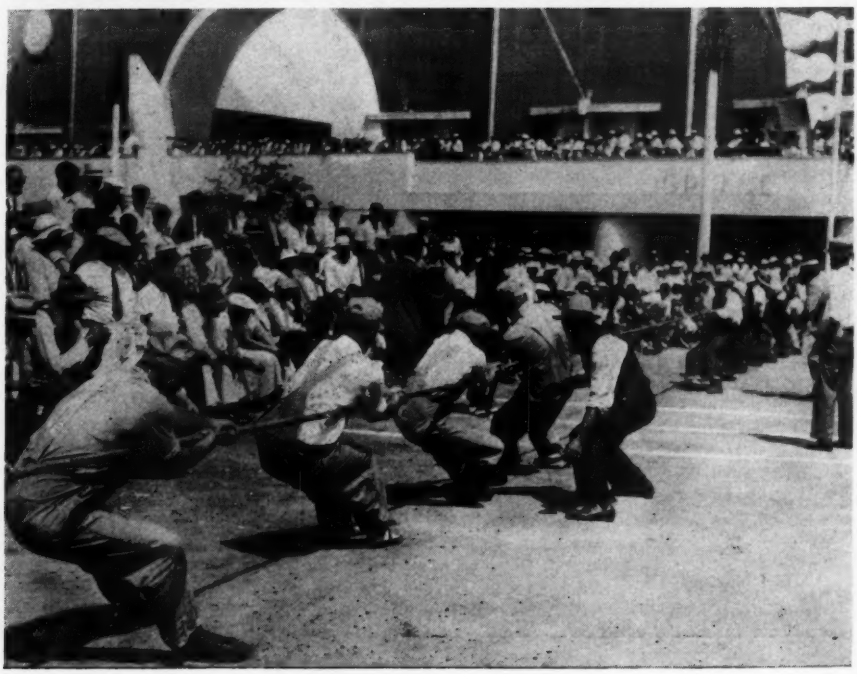


Below: Mt. Toby near Amherst, Massachusetts.



Left: Mrs. Charles Hayes of Alta, Illinois, was crowned Queen of America's Husband Callers at the World's Fair in Chicago, August 18.

Below: Dane County, Wisconsin, won in the finals of the tug-of-war contest held during Farmer's week at the World's Fair.



The Editors Talk

Adequate Fertilizer Statistics

When fashion demanded an elaborate preface to books as to the why and wherefore of another volume appearing on the scene, it was frequently the custom to include in the apologia of a technical or scientific book the statement that it was written "to fill a long-felt need." These words could have been used with reason and justification by A. L. Mehring and A. J. Peterson if they had written a preface to their recent pamphlet "Changes in Composition of American Fertilizers, 1880-1932," issued as United States Department of Agriculture Circular 315. The authors have collected data on the consumption of nitrogen, phosphoric acid, and potash in mixed fertilizers by States and for the country as a whole, and expressed the results in terms of average composition of fertilizers.

These significant and interesting data show that since 1880 the nitrogen and potash contents of complete mixed fertilizers have increased considerably, the latter more than the former, while phosphoric acid has increased slightly. Total plant food in the fertilizer also has increased. These mixed fertilizers constitute the bulk of fertilizers consumed. Mixtures containing only phosphoric acid and potash are much lower in tonnage, but have changed more in composition. During the same period, phosphoric acid content in these increased very little, while potash increased over four times.

Of the materials used in making the fertilizer mixtures, nitrogen compounds have changed the most since 1880. The proportion of nitrogen derived from organic material has greatly decreased, while the ammonia compounds used in fertilizers have greatly increased. The phosphoric acid and potash carriers have changed comparatively little.

The authors point out that the percentage of filler in fertilizers also has increased. However, the curves for total plant food and filler are about parallel for the last several years. Thus, in spite of the increase in filler, the fertilizer contains more plant food. This shows that the increased filler is due to the increased use of more concentrated fertilizer materials. Any criticism for filler in mixed fertilizers should not be leveled entirely at the manufacturers, since the customers indirectly demand it. Too often the manufacturers have found that a 6-12-12 fertilizer without the filler will not compete with a 4-8-8 with filler, because the price per ton of the latter is lower. When fertilizers are bought by analysis rather than entirely by price per ton, the filler in fertilizers will decrease to that necessary to maintain good mechanical condition. Much progress is being made in this direction, but the data show that great improvement still is needed.

The average composition of complete mixed fertilizers in the various States for a number of years also is given. The analyses vary considerably from State to State, not only in total plant food, but also in the relative amounts of nitrogen, phosphoric acid, and potash in the mixtures.

To give a complete picture, it would have been well to have included in

the publication total plant-food consumption in the States and in the country, so as to include the materials used without mixing and also the fertilizers containing two nutrients. In some States the picture would not be much different from that given by the complete fertilizer data, but in others there probably would be appreciable differences.

The authors are to be complimented on the excellent compilation they have prepared. The task involved can be appreciated fully only by those who have worked with fertilizer statistics in this country. With fertilizer control in the hands of each State to handle as it sees fit, there is as yet no uniformity of the keeping of data. Some States compile excellent and complete data, others almost none. The control officials, through an association, have agreed on uniform methods of chemical analyses of very high standards. It would seem as though they should be able also to agree on uniform and adequate methods of keeping data on fertilizer and plant-food consumption. It is to be hoped that Mehring and Peterson's circular will hasten the time when the country will have adequate fertilizer statistics.

Lifelong Learning

Schools and colleges soon will be opening. For those of us who have passed our "school days" there is sound advice in some recent remarks by Professor Leon J. Richardson, Director of the University of California Extension Division.

"We learn as long as we live," he says. "School days end, but education goes on, either moving aimlessly like driftwood or progressing like a well-managed ship. We learn from work and experience, from people, from reading, and, if ambition has not forsaken us, from study.

"Every man should give himself unstintingly to his vocation, which in the course of his life will turn out to be a great thing, if not the greatest thing. As he goes along he will do well, as opportunities arise, to improve himself; for no one can be fully trained in youth. However painstaking he may be in his work, he will from time to time miss some aim through his limitations. One man's success is hampered by the defective use of the English language; another lacks some branch of mathematics or science; still another needs a better grasp of economics or similar foundational subject. An engineer may chance to meet a person who enjoys discussing philosophy. A new world dawns upon him. His leisure hours are soon occupied by a new line of study. He is rounding out his nature, being carried forward by what Carlyle called a 'self-perfecting vitality.'

"We wish to know what is going on; what the progress of science is; what leaders of the nations are doing; how our civilization is faring; and whether our community is what it should be. Though the matters to be dealt with are multifarious, one thing comforts us: only a people rich in culture has a wealth of problems. Nations that have slipped backward have been governed too little by what they knew or might have known, too much by indifference or superstition. Great changes swept over them before they realized what was happening. We wish to be alive to our country's needs and play a part in meeting them. We aspire to be free, realizing that freedom in our world of dense population is no longer a by-product of vacant lands, but a cultural achievement."

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture and the State Experiment Stations relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

General fertilizer recommendations for various crops on different soils are issued in bulletin form by a number of Experiment Stations. These publications serve as handy and practical references and guides in the use of fertilizers. The latest recommendations in North Carolina, Ohio, and Michigan are contained respectively in North Carolina Agricultural Extension Circular 199, "Fertilizer and Lime Recommendations for Vegetable Crops in North Carolina" by E. B. Morrow, H. R. Niswonger, and R. Schmidt; Ohio Agricultural Extension Bulletin 136, "Fertilizing Field Crops in Ohio" by R. M. Salter and E. Jones; Michigan Agricultural Experiment Station Circular Bulletin 53, "Fertilizer Recommendations for 1934" by C. E. Millar, G. M. Grantham, and P. M. Harmer.

Cranberries are an important crop in some localities, but information on their proper fertilization is rather scarce. Investigations under the direction of the New Jersey Cranberry and Blueberry Substation are therefore of special value and interest. Fertilizer recommendations based on this work have been summarized by C. S. Beckwith in New Jersey Agricultural Experiment Station Circular 313, entitled "Cranberry Fertilizer." The conditions under which fertilizer should be used, the most advantageous mixtures, and the results likely to be obtained are given. It is stated that the proper use of fertilizer will increase the total crop, increase the size of the individual berries, and reduce the amount of rot.

A careful study of the effects on the plant, from a chemical standpoint, of a deficiency of potassium has been made by T. G. Phillips, T. O. Smith, and R. B. Dearborn, reported in New Hampshire Agricultural Experiment Station Technical Bulletin 59, "The Effect of Potassium Deficiency on the Composition of the Tomato Plant." The authors compared tomato plants receiving all necessary nutrients with plants from which potassium had been withheld during the latter period of growth. The plants were harvested before fruiting and analyzed. The potassium-deficient plants, although showing clear signs of a lack of potassium, were not so stunted and abnormal as were the plants grown throughout the period without this nutrient. The comparisons the authors thus obtained would probably more nearly resemble conditions in the field when the plant was insufficiently fertilized with potash. The results showed that the plants grown with potassium were larger and heavier, with more ash, dry matter, and potassium, but with lower percentages of dry matter, sugars and starches, calcium, magnesium, and phosphorus. Very noticeable were the higher amounts of potassium in the more actively growing portion of the potassium-deficient plants than in the older parts of these plants, again showing that the older parts of the plants were being robbed of their potassium in an effort to keep

the plant growing. An interesting discussion of the results in comparison with the findings of other investigators is given.

A comprehensive survey of the phosphorus and potash needs of Vermont pasture soils was made by G. L. Lea and A. R. Midgley and the results published in Vermont Agricultural Experiment Station Bulletin 373, entitled "Available Potash and Phosphorus Contents of Vermont Pasture Soils." Samples of the various types of soils, as mapped by the soil survey, were systematically taken and the acidity, lime requirements, and available phosphorus and potash were determined. The results showed that nearly all soils were low in lime and phosphates, and a large majority were low in potash. The data correlate well with the soil types and permit general conclusions to be drawn as to the probable fertility of the various groups of soils. More or less standardized methods were used in the lime requirement and phosphate determinations, but lack of such a method for potash determinations necessitated a comparison of several methods. Investigators will find interesting the results of this comparison, as well as the methods used in conducting a State-wide survey of soils in relation to fertility and crop production.

"The Use of Limestone in Mixed Fertilizers," Agr. Exp. Sta., Auburn, Ala., Cir. 67, June, 1934, J. W. Tidmore and C. F. Simmons.

"Laboratory and Greenhouse Studies of Rice Nutrition," Agr. Exp. Sta., Fayetteville, Ark., Bul. 302, May, 1934, L. C. Kapp.

"Commercial Fertilizers, Agricultural Minerals for the Year 1933," Dept. of Agr., Sacramento, Calif., Spec. Publ. 124, 1934.

"Nitrogenous Fertilizers for Top-dressing Field Crops," Agr. Exp. Sta., Lafayette, Ind., Bul. 386, Nov., 1933, A. T. Wiancko, G. P. Walker, and R. R. Mulvey.

"Liming New Hampshire Farm Lands," Agr. Exp. Sta., Durham, N. H., Sta. Cir. 44, Apr., 1934, Ford S. Prince and Paul T. Blood.

"Inspection of Commercial Fertilizers for 1933," Agr. Exp. Sta., Durham, N. H., Bul. 278, Dec., 1933, T. O. Smith and H. A. Davis.

"Five Years' Results on Pasture Fertilization and Rotation Management," Agr. Exp. Sta., New Brunswick, N. J., Bul. 564, Apr., 1934, Carl B. Bender.

"Relation of Nitrate Nitrogen to the Carbohydrate and Nitrogen Content of Onions," Agr. Exp. Sta., Ithaca, N. Y., Memoir 156, Mar., 1934, A. L. Wilson.

Soils

A handy compendium of information on "Soil Management in Kentucky" has been prepared by Professor G. Roberts in Kentucky Agricultural Extension Circular 272. In this are considered briefly, but adequately, soil tillage, erosion control, fertilizers and their use, liming, organic matter, and rotations. Farmers, County Agents, and Teachers of Vocational Agriculture will find this bulletin very useful and practical.

One of the important problems of an Agricultural Experiment Station is to be able to tell a farmer what he needs on his farm. General recommendations of what fertilizer is likely to be beneficial can be made, but soils are so variable and so influenced by previous treatment, that a general recommendation might not suit conditions on a particular farm. Soil samples may be sent to the Experiment Station, so that the officials can have an idea of what the soil is like. However, this often has not been of much help, since just looking at the soil does not tell much as to the actual state of its fertility. The expense and shortcomings of complete chemical analyses of soils are too well known to need enlargement here. Recent developments of short chemical methods for testing soils for their acidity and available nutrients have gone a long way to simplify this problem. These tests still present many problems of interpretation, but even in their present stage of development they permit much more accurate recommendations than formerly could be made. Recent publications show how three States are handling the situation. Connecticut Agricultural Experiment Circular 95, "The Interpretation of Soil Tests" by M. F. Morgan, gives a resume of what the tests can show and how they are interpreted. Massa-

chusetts Agricultural Extension Leaflet 56, "Chemical Examination of Soils" by A. B. Beaumont, discusses briefly the problems as mentioned above and tells how the Experiment Station can help farmers to obtain the information on their soils which they may want. J. B. Hester in Virginia Truck Experiment Station Bulletin 82, "Micro-Chemical Soil Tests in Connection with Vegetable Crop Production," gives a more complete discussion of soil tests for fertilizer needs. Results of the tests on soils of known treatment are included to show their reliability and practicability. Instructions on how to take a satisfactory soil sample and the information that should be sent to the Experiment Station with the sample, so that the tests can be interpreted more intelligently, are given.

"Effects of Frequent Fires on Chemical Composition of Forest Soils in the Longleaf Pine Region," Agr. Exp. Sta., Gainesville, Fla., Tech. Bul. 265, March, 1934, Frank Heyward and R. M. Barnette.

"A Study of the Colloidal Fraction of Subsoils from the Standpoint of Electrodializable Bases and Buffering," Agr. Exp. Sta., Newark, Del., Bul. 186, Tech. 14, Oct., 1933, P. B. Myers and G. M. Gilligan.

"Soil Survey of the El Cajon Area, California," U. S. D. A., Washington, D. C., Series 1930, No. 15, R. Earl Storie and E. J. Carpenter.

"Soil Survey of Washington County, Iowa," U. S. D. A., Washington, D. C., Series 1930, No. 17, C. L. Orrben and W. H. Buckhannan.

"Soil Survey of Craven County, North Carolina," U. S. D. A., Washington, D. C., Series 1929, No. 23, R. C. Jurney, W. A. Davis, and J. J. Morgan.

"Soil Survey of Greenwood County, South Carolina," U. S. D. A., Washington, D. C., Series 1929, No. 26, F. R. Lesh, B. H. Hendrickson, A. H. Hasty, W. J. Latimer, and S. R. Bacon.

"Soil Survey of Grayson County, Virginia," U. S. D. A., Washington, D. C., Series 1930, No. 19, R. E. Devereux and G. W. Patteson.

"Soil Survey of Hardy and Pendleton Counties, West Virginia," U. S. D. A., Washington, D. C., Series 1930, No. 14, B. H. Williams and H. M. Fridley.

Crops

The 1934 Yearbook of the United States Department of Agriculture is in circulation. Secretary Wallace in his foreword states: "In this book the Department reports what has been done recently toward adjusting production and promoting efficiency . . . . These two kinds of departmental activity do not conflict, but go together. Agriculture needs not less science in its production, but more science in its economic adjustment." Undoubtedly this Yearbook will be eagerly sought by those who wish to fully understand what has been accomplished along these lines during the past year.

Among the other publications which have come to hand this month, several on pastures seem to indicate the growing interest in a profitable management of this important farm crop. Bulletins on the subject from different sections of the country widen the scope of information already obtained.

"Forty-third Annual Report Fiscal Year Ending June 30, 1932," Agr. Exp. Sta., Auburn, Ala., M. J. Funchess.

"Summary of Research 1887-1933—Forty-fifth Annual Report," Agr. Exp. Sta., Fayetteville, Ark., Bul. 297, Apr., 1934, Dan T. Gray, E. B. Whitaker, G. W. Ware, and G. H. Banks.

"Genetic Relations of Nankeen Lint to Plant Color and Leaf Shape in Upland Cotton," Agr. Exp. Sta., Fayetteville, Ark., Bul. 300, May, 1934, J. O. Ware.

"Oat Variety and Production Studies," Agr. Exp. Sta., Fayetteville, Ark., Bul. 301, May, 1934, C. K. McClelland.

"Bush Berry Culture in California," Agr. Exp. Sta., Berkeley, Calif., Ext. Cir. 80, Dec., 1933, H. M. Butterfield.

"Growing and Handling Garlic in California," Agr. Exp. Sta., Berkeley, Cal., Ext. Cir. 84, Feb., 1934, Roy D. McCallum.

"Tobacco Substation at Windsor—Report for 1933," Agr. Exp. Sta., New Haven, Conn., Bul. 359, Feb., 1934, P. J. Anderson, T. R. Swanback, and O. E. Street.

"Annual Report of the Extension Service in Agriculture and Home Economics," Agr. Exp. Sta., Newark, Del., Bul. 20, Feb., 1934, C. A. McCue.

"Annual Report of the Director for the Fiscal Year Ending June 30, 1933," Agr. Exp. Sta., Newark, Del., Bul. 188, Mar., 1934, C. A. McCue.

"Transactions of the Peninsula Horticultural Society 1933," State Bd. of Agr., Dover, Del., Bul. Vol. 23, No. 5.

"1933 Report Cooperative Extension Work in Agriculture and Home Economics," Agr. Exp. Sta., Gainesville, Fla., Wilmon Newell.

"Cultural Practices for Alfalfa in Northern Idaho," Agr. Exp. Sta., Moscow, Idaho, Cir. 72, Mar., 1934, H. W. Hulbert and F. L. Burkart.

"Asparagus Yields as Affected by Severity of Cutting," Agr. Exp. Sta., Urbana, Ill., Bul. 401, Apr., 1934, E. P. Lewis.

"How Use Contracted Acres—Some Questions and Answers," Agr. Exp. Sta., Urbana, Ill., Cir. 420, Apr., 1934, J. C. Hackleman and C. M. Linsley.

"Aster Culture," Agr. Exp. Sta., Lafayette, Ind., Cir. 200, Oct., 1933, E. R. Honeywell.

"Report of the Agricultural Experiment Station for the Years 1931-1933," Agr. Exp. Sta., Baton Rouge, La., C. T. Dowell.

"Cotton Spacing in Southern Louisiana in Relation to Certain Plant Characters," Agr. Exp. Sta., Baton Rouge, La., Bul. 246, Mar., 1934, John R. Cotton and H. B. Brown.

"Sugar Cane Variety Report 1933," Agr. Exp. Sta., Baton Rouge, La., Bul. 247, Apr., 1934, C. B. Gouaux and E. C. Simon.

"The Forty-Sixth Annual Report of the University of Maryland, 1932-1933," Agr. Exp. Sta., College Park, Md., H. J. Patterson.

"Producing Snap Beans for Canning," Agr. Exp. Sta., College Park, Md., Ext. Cir. 104, Mar., 1934, T. D. Holder and H. A. Hunter.

"Soybeans for Massachusetts," Agr. Exp. Sta., Amherst, Mass., Bul. 309, May, 1934, A. B. Beaumont and R. E. Stitt.

"Seventy-second Annual of the Secretary of the State Board of Agriculture and Forty-sixth Annual Report of the Experiment Station From July 1, 1932 to June 30, 1933," Agr. Exp. Sta., Lansing, Mich., H. H. Halladay and V. R. Gardner.

"The Quarterly Bulletin," Agr. Exp. Sta., East Lansing, Mich., Vol. 16, No. 4, May, 1934.

"Oats in Minnesota," Agr. Exp. Sta., Univ. Farm, St. Paul, Minn., Spec. Bul. 165, Dec., 1933, H. K. Hayes, H. K. Wilson, and R. F. Crim.

"Tung Oil—Mississippi's New Agricultural Industry," State Dept. of Agr., Jackson, Miss., Bul. No. 1, June, 1933, E. Squire Brooks.

"Report from Holly Springs Branch Experiment Station for 1933," Agr. Exp. Sta., State College, Miss., Bul. 302, Dec., 1933, C. T. Ames.

"Cultural Practices in Winter Wheat Production," Agr. Exp. Sta., Lincoln, Neb., Bul. 286, Apr., 1934, T. A. Kiesselbach, Arthur Anderson, and W. E. Lyness.

"Annual Report of the Board of Control for the Fiscal Year Ending June 30, 1933," Agr. Exp. Sta., Reno, Nev.

"Agricultural Research in New Hampshire," Agr. Exp. Sta., Durham, N. H., Bul. 280, Mar., 1934, J. C. Kendall.

"The New Jersey Standard for Judging the Growth Status of the Delicious Apple," Agr. Exp. Sta., New Brunswick, N. J., Bul. 559, Feb., 1934, M. A. Blake and O. W. Davidson.

"Improving Pastures in New Jersey," Agr. Exp. Sta, New Brunswick, N. J. Bul. 565, Apr., 1934, H. B. Sprague, N. F. Farris, and C. S. Cathcart.

"Effects of Temperature on the Growth and Composition of Stayman and Baldwin Apple Trees," Agr. Exp. Sta., New Brunswick, N. J., Bul. 566, Apr., 1934, G. T. Nightingale and M. A. Blake.

"Effects of Temperature on the Growth and Metabolism of Elberta Peach Trees with Notes on the Growth Responses of Other Varieties," Agr. Exp. Sta., New Brunswick, N. J., Bul. 567, Apr., 1934, G. T. Nightingale and M. A. Blake.

"Garden Iris," Agr. Exp. Sta., New Brunswick, N. J., Ext. Bul. 121, May, 1934, Charles H. Connors.

"The Place of Field Crop Production in New Jersey," Agr. Exp. Sta., New Brunswick, N. J., Cir. 294, Feb., 1934, Howard B. Sprague.

"Hardy Chrysanthemums," Agr. Exp. Sta., New Brunswick, N. J., Cir. 315, Apr., 1934, Charles H. Connors.

"Results of Irish Potato Experiments in the Bluewater, New Mexico, Irrigation District," Agr. Exp. Sta., State College, N. M., Bul. 218, Jan., 1934, Fabian Garcia and S. C. Young.

"Red Currants and Gooseberries," Agr. Exp. Sta., Geneva, N. Y., Cir. 112 (Rep.), Jan., 1933, G. L. Slate.

"Growing Wood as a Crop on New York Farms—Part 1—Trees and Products," Agr. Exp. Sta., Ithaca, N. Y., Ext. Bull. 270, Nov., 1933, J. A. Cope.

"The Control of Diseases and Insects Affecting Vegetable Crops on Long Island," Agr. Exp. Sta., Ithaca, N. Y., Ext. Bul. 278, Jan., 1934, C. R. Crosby and Charles Chupp.

"History, Culture, and Varieties of Summer-Flowering Phloxes," Agr. Exp. Sta., Ithaca, N. Y., Bul. 588, Mar., 1934, A. M. S. Pridham.

"Soil, Field-Crop, and Pasture Management for Suffolk and Nassau Counties, New York," Agr. Exp. Sta., Ithaca, N. Y., Bul. 600, May, 1934, A. F. Gustafson, D. B. Johnstone-Wallace, and F. B. Howe.

"A Study of Some Ecological Factors Influencing Seed-Stalk Development in Beets," Agr. Exp. Sta., Ithaca, N. Y., Mem. 154, Mar., 1934, Emil Chroboczek.

"The Bimonthly Bulletin," Agr. Exp. Sta., Wooster, Ohio, Vol. XIX, Nos. 168 and 169, May-June and July-August, 1934.

"Walnut Production in Oregon," Agr. Exp. Sta., Corvallis, Ore., Cir. 108, Mar., 1934, C. E. Schuster.

"Forty-Sixth Annual Report 1933," Agr. Exp. Sta., College Sta., Texas, A. B. Conner.

"Abstracts of Bulletins 474-488, Circulars 67-68 and Other Publications During 1933," Agr. Exp. Sta., College Station, Texas, Cir. 71, Dec., 1933, A. D. Jackson.

"Rotations and Cropping Systems," Agr. Exp. Sta., Logan, Utah, Cir. 103, Apr., 1934 D. W. Pittman.

"The Vermont Five-Point Pasture Plan," Agr. Exp. Sta., Burlington, Vt., Ext. Cir. 79, May, 1934, P. R. Miller.

"Emergency Crops for Summer Planting," Agr. Exp. Sta., Burlington, Vt., Ext. Emerg. Leaf. 46, July 13, 1934, P. R. Miller.

"More Alfalfa for Vermont," Agr. Exp. Sta., Burlington, Vt., Ext. Brief. 388, May, 1934, P. R. Miller.

"Good Gardening in Vermont," Agr. Exp. Sta., Burlington, Vt., Ext. Brief. 387, Apr., 1934.

"Department of Agriculture Immigration of Virginia," Dept. of Agr., Richmond, Va., Bul. 316 and 317, June and July, 1934.

"A Comparison of Rotational and Continuous Grazing of Pastures in Western Washington," Agr. Exp. Sta., Pullman, Wash., Bul. 294, Apr., 1934, R. E. Hodgson, M. S. Grunder, J. C. Knott, and E. V. Ellington.

"Methods of Measuring Pasture Yields with Dairy Cattle," Agr. Exp. Sta., Pullman, Wash., Bul. 295, May, 1934, J. C. Knott, R. E. Hodgson, and E. V. Ellington.

"Farm Orchards," Agr. Exp. Sta., Madison, Wis., Ext. Cir. 265, Feb., 1934, C. L. Kuehner.

"Strawberry Culture in Wisconsin," Agr. Exp. Sta., Madison, Wis., Ext. Cir. 268, Mar., 1934, James G. Moore.

"List of Available Publications of the United States Department of Agriculture January 2, 1934," U. S. D. A., Washington, D. C., Misc. Pub. 60, (Rev.), Jan., 1934, F. L. Zimmerman.

"The United States Department of Agriculture—Its Structure and Functions," U. S. D. A., Washington, D. C., Misc. Pub. 88 (Rev.), Dec. 15, 1933, M. S. Eisenhower and A. P. Chew.

"A Pasture Handbook," U. S. D. A., Washington, D. C., Misc. Pub. 194, Apr., 1934, A. T. Semple, H. N. Vinall, C. R. Enlow, and T. E. Woodward.

Economics

"General Indicators of the Condition of Arkansas Banks," Agr. Exp. Sta., Fayetteville, Ark., Bul. 298, May, 1934, B. M. Gile and Fred L. Garlock.

"Annual Index Numbers of Farm Prices, California, 1910-1933," Agr. Exp. Sta., Berkeley, Cal., Bul. 569, Feb., 1934, H. J. Stover.

"A Study of the Cost of Handling Citrus from the Tree to the Car in Florida," Agr. Exp. Sta., Gainesville, Fla., Bul. 266, Apr., 1934, H. G. Hamilton and Marvin A. Brooker.

"Prices of Farm Products in Northwestern Indiana," Agr. Exp. Sta., Lafayette, Ind., Bul. 387, Feb., 1934, Lynn Robertson and F. V. Smith.

"Prospects for Agricultural Recovery—V. Is Our National Farm Plant Too Large?" Agr. Exp. Sta., Ames, Iowa, Bul. 314, Mar., 1934, Theodore W. Schultz.

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NATURE STUDY

Teacher of Zoology: "What is it that ladies and gentlemen have that wild beasts do not have?"

Little Eunice: "Sex appeal."

GEOGRAPHY

Teacher (in geography class): "Can anyone tell me where Pittsburgh is?"

Small Voice (in rear): "Please, ma'am, they're playing in Chicago."

Better Avocados

(*From page* 14)

next, followed by the others, with that of phosphate alone as the poorest.

The avocado requires more fertilizer than any tree-fruit in California. That should be evident to anyone who compares the avocado with other fruits. The above application of complete fertilizer may be enough for groves that have received good care in the past, but the writer has yet to see any avocado grove in California that does not contain trees that are in need of extra applications of one or more of the three chief fertilizer ingredients.

In order to increase the flavor and shipping qualities of the fruit and give the tree greater resistance to frost and disease, a 6-10-12 complete fertilizer is favored for the avocado.

A Fuerte avocado tree fertilized over a period of years with a balanced fertilizer containing generous amounts of potash.

Science Helps Maine Grow Better Potatoes

Potato-breeding experiments of the United States Department of Agriculture in Maine now give promise of overcoming some of the most baffling disease problems of potato growers throughout the country. Aroostook County, Maine, is the largest potato-producing county in the country and is likewise a center of seed production.

The most notable achievement of the plant breeders thus far is the Katahdin, a variety developed in 1931. It produces a good crop of uniform tubers with shallow eyes, and it has a remarkable resistance to the disease—mild mosaic—one of the most widespread of all potato diseases.

Varieties resistant to other diseases have resulted from the work of the Department of Presque Isle, Maine. Last year several hundred seedlings were grown in an unsprayed plot to test them for resistance to late blight. A heavy epidemic of the disease occurred, and six of the seedlings showed notable resistance. Other new varieties are resistant to scab. No variety shows resistance to all the various diseases, but the scientists believe they have now laid the foundation for the development of such a variety.

Fertilizer experiments by the Department and the Maine Experiment Station have determined the most effective proportion of nitrogen, phosphoric acid, and potash for potatoes, the best sources of fertilizer ingredients, and the most economical rate of

application. Field tests have shown that high-analysis fertilizers compare favorably with ordinary low-analysis mixtures, and many farmers are now using the concentrated forms, and are saving money on freight, bags, and hauling.

Fertilizer placement studies show that best results are obtained when the fertilizer is placed in narrow bands on each side of the seed piece about 2 inches away. Injury to the seed pieces resulting in poor stands and lowered yields often results when fertilizers are placed too near the seed.

In recent years Maine potato farmers have had many stunted plants, resulting in poor yields. Cooperative investigations showed this trouble was caused by continued use of fertilizers tending to increase soil acidity, and that the addition of magnesium compounds to potato fertilizers in the proportion of 20 pounds of magnesium oxide to the ton overcame the trouble.

The Inquiring Mind

(*From page* 12)

thousands of samples of soil, and tested them by means of cleverly contrived cylinders. In these, moist alkali-impregnated soil is saturated with water, which is forced through clay, collected and then analyzed.

As a result of his extensive experimental work, Dr. Kelley has concluded that drainage, especially if it is accompanied by flooding, is a reasonably successful means of removing white alkali from soils. If large amounts of black alkali are present, however, ordinary drainage probably will not restore the land to a state where crops will succeed, unless the black alkali first be neutralized in the soil mass. As yet he has found no economical means of neutralizing large amounts of black alkali where it occurs in the subsoil; but where it occurs mainly in the first foot of the soil, reclamation possibly may be accomplished by drainage and an application of gypsum. Sulphates and chlorates predominate in white alkali, and carbonates in black alkali. The experiments have shown that when chemical salts were applied to alkali soils, sodium replaced calcium in the clay and turned it into insoluble sodium clay which cannot be washed from the soil. Sulphur, when applied was, however, converted into sulphuric acid in the soil, and the acid dissolved the calcium carbonate, forming calcium sulphate which, in turn, made sodium clay into calcium clay, from which the salts can be removed by drainage and leaching.

In the reclamation of the Fresno, California, type of black alkali soil, Dr. Kelley has had beneficial results from the application of gypsum, sulphur, iron sulphate, and alum, but at different rates. Gypsum produced uniformly successful results on this soil only when applied at the rate of more than 10 tons per acre. Relatively large amounts of iron sulphate and alum also are required. On the other hand, excellent results have been obtained by applying not more than one ton of sulphur per acre. Sulphur has proved much more economical than the other materials. Large yields of alfalfa—6 to 11 tons per acre per annum—have been produced on soil that was badly affected with alkali and entirely unproductive at the outset by applying one ton of sulphur per acre. When used in conjunction with stable manure, 1,000 pounds of sulphur per acre has given good results.

Leaching experiments, without the

application of any material except water, thus far have failed to bring about a satisfactory reclamation of this soil.

Dr. Kelley considers it extremely important to irrigate young alfalfa on alkali soil. He has found it desirable to irrigate twice a month during the first summer after the alfalfa is planted. Alkali soil should never be allowed to dry out while crops are being grown, and success in alkali reclamation will depend to an unusual degree upon careful attention to the details of soil preparation and irrigation.

Consider Subsoil

Since injurious alkalinity commonly occurs in the subsoil as well as in the surface soil, Dr. Kelley teaches that the successful treatment of black alkali soils involves the necessity of considering the subsoil. Gypsum, although less effective chemically than elemental sulphur or sulphuric acid, nevertheless may be preferable in practice, since it is frequently necessary to employ leaching and the alkaline silicates present are capable of being converted into calcium silicates by the action of calcium salts. These silicates probably perform highly important functions in soils.

Both ferrous sulphate and alum neutralizes the CO_3 in soil, and the results of experiments have shown that either of these materials might be useful in the treatment of black alkali soil. An excess of soluble ferrous iron or aluminum is considered toxic to plants, and the precipitate formed by each of these materials is gelatinous and may produce undesirable physical properties, especially when large amounts of black alkali occur. Culture experiments extending over a period of two weeks have indicated, however, that the soil after treatment with ferrous sulphate and leaching may be a favorable medium for plant growth.

Relative to harmful ingredients in irrigation water, which have already been mentioned, Dr. Kelley says: "It has been found that a considerable number of citrus groves located in several districts in California have been severely injured by alkali and that a large percentage of the injury has been due to the irrigation water which is highly charged with alkali. Chlorides are undoubtedly the most injurious constituents that occur in the irrigation waters of Southern California, but it must not be concluded that other alkali salts can be ignored. In certain localities, some of the waters also contain injurious amounts of sulphates and carbonates."

Hilgard said: "When a large proportion of solids in irrigation water consist of carbonate of soda, or common salt, even a smaller proportion of salts than 40 grains per gallon might preclude its regular use."

Dr. Kelley and E. E. Thomas commented on this as follows: "We regret to state that a considerable number of irrigation waters contain salts in excess of this limit, some of them greatly so!"

It has been shown by Dr. Kelley that the continued application of nitrate of soda may bring about an increase in the amount of alkali in the soil. Unless drainage effectively leaches the salts from the soil, the continued application of sodium nitrate, or of saline irrigation water, will ultimately produce a harmful concentration of alkali in any soil. (Kelley-Thomas).

Disease Symptoms

An excess of chlorides causes the tips and margins of citrus leaves to become yellow or brown, followed by defoliation. An excess of sulphates and bicarbonates, on the other hand, is more likely to stunt the growth of the trees and causes the leaves to become chlorotic. More or less mottle leaf also may occur. Lemon trees apparently are injured by lesser amounts of alkali than oranges.

As a part of his reclamation work in the famous Imperial Valley, where

the land had been fertile and productive but was poisoned by alkali, our California Elisha "made the valley full of ditches," to drain away the surplus subsoil water. For the purpose, a canal 10 feet deep was dug and into it empty numerous lateral ditches which carry the alkali-impregnated water and eventually empty it into the Salton Sea. By this canal system and the surface application of gypsum, sulphur, etc., fertility has been restored, and Dr. Kelley and his enterprising helpers are given the credit for enabling growers again to produce bountiful crops of fruit, grain, and forage.

The busy Doctor has not been idle in other matters. Dr. L. D. Batchelor, Director of the Citrus Experiment Station, says that in addition to his scientific achievement Dr. Kelley has been much interested in public affairs, especially for the betterment of the community in which he lives and works. In addition, his knowledge of international affairs relating to agriculture and economics has been so sound and useful that he has been asked many times to discuss such problems at conventions of various important local and state organizations.

His congenial and cordial personality also has made him popular with his co-workers and the general public. We, with all of his friends and admirers, hope that he will be spared for many more years to carry on his work, which has been of inestimable value in California, and that he may make new discoveries in soil chemistry that will redound further to his fame and amplify his already splendid record.

Phosphorus and Potash Responses

(*From page 9*)

the trees receiving nitrogen alone, and those in the third row from trees treated with nitrogen, phosphorus, and potassium.

In the other pictures interesting responses for Grimes Golden apple trees from this same experimental layout also are brought out. Although the trees receiving nitrogen alone in the form of ammonium sulphate showed marked responses as compared to the check or unfertilized trees, the most marked response is shown in the trees receiving potash and phosphorus in addition to the nitrogen.

The following table brings out the responses of the differently treated apple trees in the second year:

TREATMENT	Average Circumference Increase in Inches	Average Terminal Growth Length Per Shoot in Inches	Average Yield in Pounds
Calcium Cyanamid 10 lbs. Fall	1.22	2.78	.74
Ammoniated Phos. 13 lbs.	1.24	5.75	4.16
Ammoniated Phos.-Pos. 17½ lbs.	1.43	6.44	3.87

In an address at the last meeting of the American Society for Horticultural Science in Boston, Massachusetts, the writer showed the significant relationship that exists between the growth responses and the yielding potentialities in apple trees. The high growth response shown in the above table for the treatment in which potash was added to the other elements is thus very significant. Although calcium cyanamid is the nitrogen source illustrated in this table, similar benefits have been secured in these experiments where other nitrogenous fertilizers also were used in the complete fertilizer combinations.

The fusion method of analysis

shows an abundance of phosphoric acid and potash in the soil but according to the fifth normal nitric acid solubility method, the amounts present in available form as plant food are inadequate to maintain capacity growths and crops for apple trees planted 40 feet apart after they have reached a 40-inch trunk circumference or approximately after some 25 years as shown in Table I.

What to Consider

It is quite possible that there may be adequate amounts of the essential elements in Virginia soils to produce optimum growth and yields in apple trees for even more than the average life of apple trees. Furthermore, disintegrating rock and certain chemical changes in the soil may release sufficient amounts that can be utilized. On the other hand, however, losses that may be caused in various ways also must be borne in mind. In addition to elements tied up in wood and removed in picked fruit, losses may be caused by leaching as well as from mechanical and chemical fixation. The ultimate occupation of the soil by the roots and the consequent displacement of this area by them, also should be considered. Even in 40 by 40 feet planting distances the soil areas will become appreciably occupied so that the trees become practically root-bound. Even if there are considerable unexploited depths in the subsoil, the heavy texture may preclude efficient penetration. When trees reach such a condition they are in danger of reaching a physiological limit, and as a consequence going on a down grade into old age or senescence. To anticipate this limit and thereby postpone a down grade into senescence it should be advisable to provide all of the essential elements.

It is rather difficult to recommend definitely how much of these three elements should be used in the profitable production of apples. In a large measure trial and error procedure must still be resorted to. The analyses presented at the beginning of this discussion may offer some suggestion as to the proportions that are required. For every thousand pounds of apples harvested together with the usual amount of pruning that should be done for the production of so many apples, there should be restored to the orchard soil thus depleted, .6 pound nitrogen, .16 pound phosphoric acid, and .48 pound potash. This suggests a ratio of approximately 7-2-5. An application measured upon this basis should be profitable at least from the standpoint of maintaining available plant food at just about the rate that the apple tree needs it for normal growth and fruit production. A basis is also suggested for figuring the fertilizer expense for a definite amount of fruit. This suggested ratio should, of course, be modified to meet special conditions and differences in soil fertility. To also take care of non-leguminous cover crop needs and what may be tied up in the wood, a 7-6-5 ratio based upon an ammonia percentage for nitrogen is suggested where more nitrogen is needed and a 4-8-5 for soils planted to legumes or those richer in nitrogen.

How to Apply

In another set of experiments in this same apple orchard a most marked response contrast showed up wherever either phosphorus or potassium or both were added to calcium cyanamid. The response was so outstanding that apple growers are advised to give these combinations very special attention. It is the conclusion of the writer that far better benefits can be secured from calcium cyanamid when either or both, preferably both, phosphorus and potash are added to the calcium cyanamid applications. The better results are secured if the calcium cyanamid is applied first, then the superphosphate on top of this, with the potash to the last. It is not well to apply the superphosphate first as it fixes very soon in the upper soil layers. If applied on top of the calcium cyanamid, it has a

good chance to unite with the ammonia given off and become ammoniated. As ammoniated phosphorus, it is highly available and more efficiently distributed. We have found it better here at this station to scatter these different fertilizers directly in the orchard than to go to the additional trouble of mixing them before hand. Orchardists may prefer to do the latter but we believe that, on the whole, time will be lost as compared to making the applications directly in the orchard. We also have found we get satisfactory results by scattering the fertilizer between the rows as well as entirely under the branches of the tree. This is particularly so with the older trees. With the older trees, the roots often meet even in 40 by 40 feet planting distances.

This is a good time to think and talk over fertilizer problems. The fall will often arrive just a bit too soon. For best results, these applications should be made in the fall. Wherever his apple trees need fertilizing, the wise apple grower will do best to make his preparations for fall applications and make his plans well in advance.

Nature & Co.

(*From page 6*)

tend to indicate that there are cycles of dry weather in the growing season over vast sections of the country usually blessed with ample soil moisture. If that can be refined a bit and charted a little closer to accurate determinations, the time is coming when farmers can escape the bad results of low feed reserves by timely warnings. As it is now, you can't get a highly scientific weather expert to risk his reputation betting against Nature for the sake of the Company. One week in advance is considered a long shot.

Then by combining that acquired wisdom with the ancient program of Joseph when he was custodian of the grain bins for Pharaoh, we are probably going to set aside rigidly withheld portions of the food and feed harvests for stuffing the ribs of man and beast in lean years, always being extra careful to ear-tag the surplus so that speculators will not punish the farmer for using fertilizer and good tillage to grow it. And the sob-sisters who weep briny tears over control of production when some folks are starving, will also be quieted by a judicious use of such surplus.

Trying to enforce mutual welfare regulations against recalcitrant human Nature is just about as tough a task as gambling against the hazards of elemental Nature. In other words the grand old constitution and its fancied rights to every man to pursue the dollar over the halt, the lame, and the blind is still a precedent that tangles up the reformers.

HUMAN Nature run amuck puts us up against half of our troubles with Nature. Witness the land-go-mania in all its aspects and the inescapable consequences, timed to a tragic nicety with the boom in stock and land values and the financial fevers of the past decade. Some folks said it was all a freak coincidence or a plague in punishment. It would be better to call it bad management on the part of the Junior Partner—& Company.

Reformers and adjusters have two courses open to them in negotiating "treaties" with reluctant human Nature for the supposed general welfare of the Company. The one method is to use diplomacy, discretion, and patient arbitration, education, and pleading. The second system is the rough and tumble, hard-boiled way, which

leads to much open debate and gross billingsgate on both sides, threats and innuendoes, and perhaps a round or two in lower and higher courts.

Your author, if you please, has had some experience in both. The proper tactics to follow so as to gain the ends sought and produce the desired reform and adjustment needful for the Company at large depend on the issue itself and its clarity, and the degree of meanness and its capital resources involved.

Likewise, they depend on how sincere and well-equipped the reformers are to undertake the pressure required to see the issue through to the bitter end. It is idle to remark that the courts are the resort of knaves as long as the reformers seem to have little serious intention to carry the cases into court and meet the knaves with their own weapons. Before the issue really gets to court it is tried in newspapers and rumblings of public opinion often shatter the firm resolve of reformers.

At this stage all bombastic attitudes and charges of graft assume a childish aspect on the part of reformers, as they might get equally far by sticking out their tongues at public enemies. In a democracy where votes and vetoes are imminent, the pursuit of the economic highbinder through the mazes of punishment is a calling for calloused dictators.

IF recourse is taken to a sort of vindictive educational method in lieu of drastic court enforcement, we at once divorce ourselves from practical considerations. The knaves and grafters whom we seek to reform by pressure or persuasion still live, own their institutions, hire and fire employees, and continue to be a concrete part in the economic picture. By a continual attitude of criticism toward them, the reformer, unsupported by enough fundamental law, is helpless to take action and is obliged to fret and fume in a hot-bed of bad feeling which engenders rather than removes the real source of trouble.

I reckon we have not proceeded far enough yet to discount human Nature, in or out of court. It does not seem logical to advocate resignation in the midst of such a wave of righteous anger at discredited agencies. Something should be done to take advantage of the white-hot heat in which the Company of Citizens finds itself before that temperature cools down. Without show of fight or sign of practical action to follow up the gestures of reform, however, there is danger that the ardor will die out with a return of somewhat more easy economic conditions. In other words, "put up or shut up."

YET this is not any time to feel discouraged over the possibilities of making things safer and better for the Company. It is a gradual process and some real objectives have been reached in our attempt to set up social insurance against the crudities of all forms of Nature. The protection against all forms of over-emphasis and over-expansion is a hard lesson to learn, especially when self-imposed. It will take decades to settle this and tons of grease to stop the creaking.

After all, our principal comfort lies in this fact: That the tantrums of Dame Nature and the instances of human deviltry are more an exception than the rule; and most climates and most peoples are more civilized and tractable than they get credit for.

Nature itself probably always was that way, and we can't give the credit to reformers for this. Human cussedness was far more general and damaging a few hundred or a thousand years ago than it is today. I am sure the reformers and adjusters deserve due recognition for part of this improvement.

Most of us feel that, biding the time of renascence, we can best survive by dodging the blows of the elements and the schemes of mankind. In doing this, of course, we remain in a state of suspension——mighty dizzy in our domes.

FITTING NO OBJECT

An old Negro recently approached a relief worker and asked for clothing. He particularly wanted a pair of pants.

"What size do you wear?" he was asked.

"A 38."

"I'm afraid I don't have your size," she informed him. "The smallest I have is a size 50."

"Well, that's all right. You see, Miss, we ain't so much for fittin' as for hidin'."

Ants are supposed to be the hardest working creatures in the world. Yet they seem to have time to attend all picnics.

A NEW OFFICE

Rastus: "Brothaw president, we needs a cuspidor."

President of the Eight-Ball Club: "I appoints Brother Brown as cuspidor."

"Do you know how to tell a professor from a student?"

"Oh, all right, have it your own way and tell it."

"Ask him what 'it' is, and if he says it's a pronoun he's a professor."

Professor: "Name the five most common bugs."

Student: "June, tumble, lady, bed, and hum."

FATE TOOK A FOOT

Teacher (after recess): "Percy, why are you crying?"

Percy: "Harold kicked me in the stomach."

Teacher: "Harold, did you mean to kick Percy in the stomach?"

Harold: "Naw. He turned around just when I kicked."

Timothy Hay: "Yes, I've seen a few bad crop years in my time, too. One year our string beans were so poor that the crop didn't even pay for the string."

Al Falfa: "That's nothing, Tim. In '94 our corn was so bad that my old dad, who had a very poor appetite, ate up 14 acres of corn at a single meal."

An old lady in church was seen to bow whenever the name of Satan was mentioned.

One day the minister met her and asked why she did so.

"Well," she replied, "politeness costs nothing, and—you never know!"

He is a wise man who has his afterthoughts first.

DIDN'T SHOW

"Oh, dear," exclaimed the girl student who was planning to go to college next fall, "I just can't adjust my curriculum to save my life."

"It doesn't show any," snickered the boy friend.

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